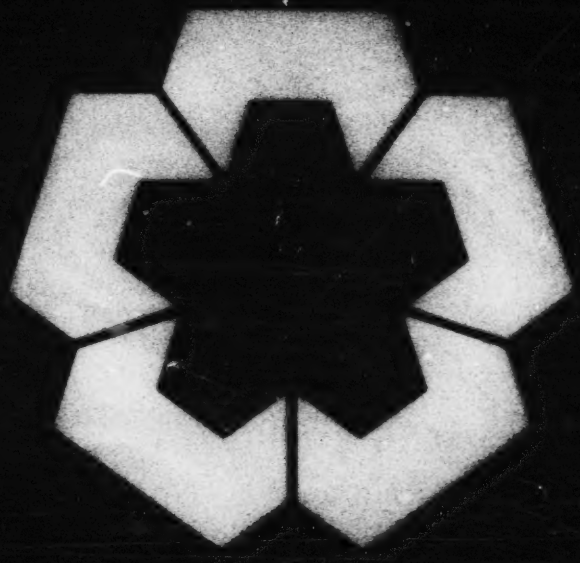

The logo represents the interdisciplinary and holistic nature of the Division's environmental research programs. Each of the five sections of the symbol represent comprehensive programs on air, water, land, humans, and their constant interaction. The sections converge to form a cohesive chain, characteristic of an effective research organization. This cohesive bonding makes the sections blossom into the environment in the form of a flower — an Albertan wild rose.

RESEARCH MANAGEMENT DIVISION

ANNUAL REPORT

FOR THE FISCAL YEAR

1982/83

Research Management Division
Alberta Environment

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RESEARCH MANAGEMENT DIVISION
ANNUAL REPORT
FOR THE FISCAL YEAR
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RESEARCH MANAGEMENT DIVISION
Alberta Environment

RMD 83/22

August 1983

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INTRODUCTION

The objectives of the Research Management Division (RMD), Alberta Environment, are: to provide timely and authoritative scientific and technical information to other operational units within Alberta Environment; to plan and co-ordinate the scientific environmental planning requirements of the department; and to carry out research on environmental matters which is pertinent to departmental needs. Activities included in these objectives are the identification of the long-term environmental research program requirements and the implementation of the chosen programs and projects. The information contained in this document represents the third annual report of RMD work activities.

During 1982/83, a report by Dr. E.E. Ballantyne which studied environmental research and its management by Alberta Environment was accepted by the departmental Executive Committee. Recommendation 2 of the report states that RMD "will be the research management arm of the department. Its mandate includes the responsibility for planning and management of research programs and projects, co-ordination of inter-departmental and inter-agency research programs, preparation and publication of research documents, and provision of scientific advice and support services to departmental staff. These responsibilities are covered under Section 8 of the Department of the Environment Act (1971)." The Research Management Division will also take on a greater responsibility in the co-ordination of those departmental research requirements which are handled at the Alberta Environmental Centre at Vegreville.

Divisional Organization

During the reporting year, RMD operated under a matrix program management system. The previous functional management mode, comprised of four scientific teams or systems (Air, Human, Terrestrial, and Water), was combined with a program management mode in order to integrate the best features of both organizational systems.

RESEARCH MANAGEMENT DIVISION

ORGANIZATION CHART

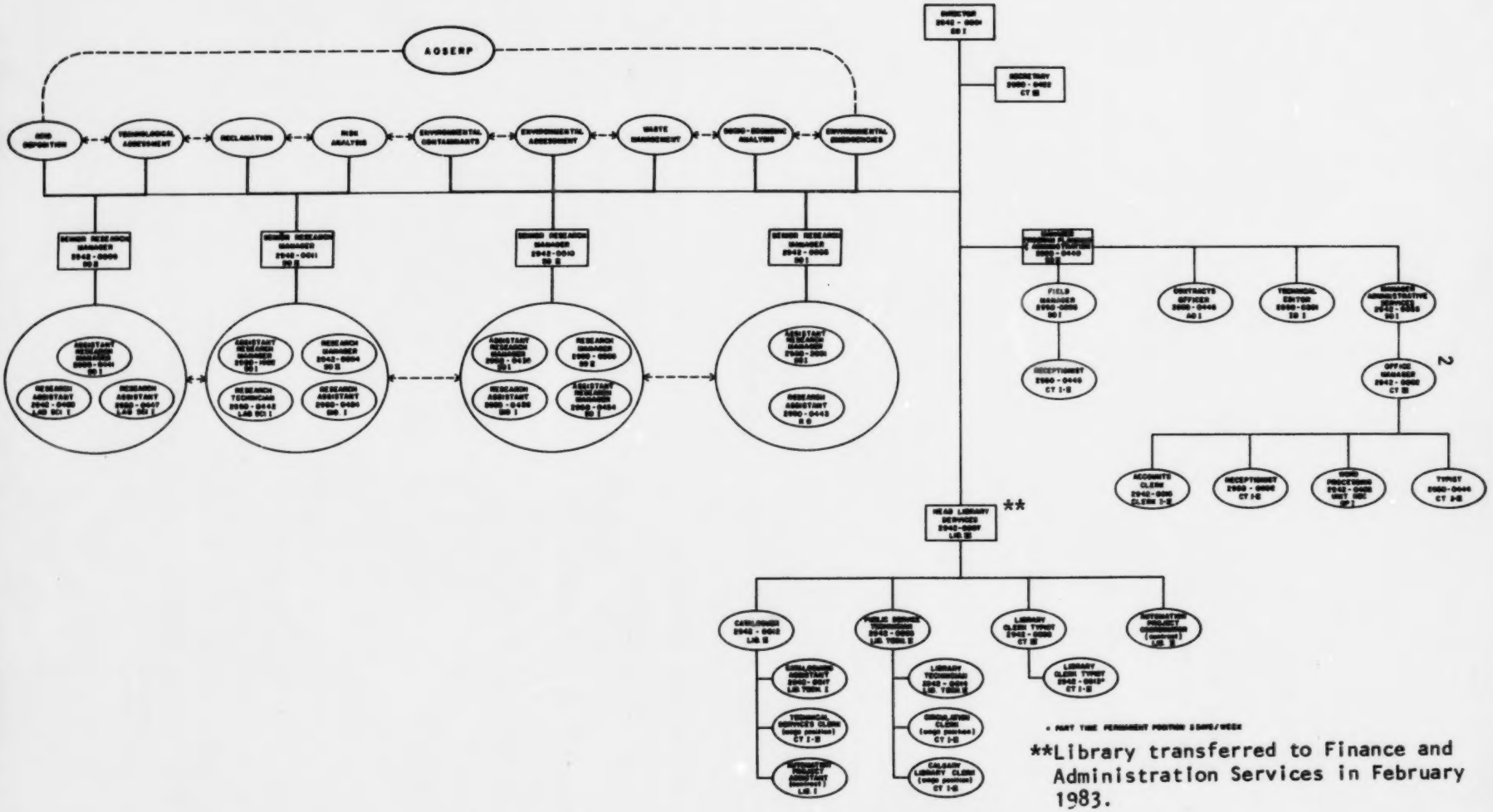

Figure 1. Organizational chart of the Research Management Division.

The organizational chart (Figure 1) outlines the division's new management structure. Of the programs shown, the following were fully active during the fiscal year:

1. Alberta Oil Sands Environmental Research Program (AOSERP)
2. Acid Deposition
3. Reclamation
4. Environmental Contaminants
5. Waste Management
6. Socio-Economic Analysis

The first program, AOSERP is a continuation of a program started in 1975 as a federal/provincial study, but taken over solely by the province of Alberta in 1979. As the organizational chart shows, research from all of the other program areas contributes to AOSERP.

A comprehensive program description document was prepared for each of the five other programs listed above, and ongoing research projects were assigned to suitable programs. New projects were also developed to meet the future research objectives of each program. Projects were assigned to appropriate staff members.

The remaining programs shown on the organizational chart (Technological Assessment, Risk Analysis, Environmental Assessment, and Environmental Emergencies) concerned more recently-developed research areas and at the year's end were being reviewed to ensure their proper planning. This review process is ongoing within RMD and serves to regularly update the relevance of the division's research thrusts.

In the past, the library had been a functional unit of RMD. However, this responsibility was transferred to the Finance and Administration Services in February 1983.

Operational Activities

In its research support capacity within the Department of Alberta Environment, the Research Management Division identified, funded, managed, and reviewed environmental research projects in Alberta. It provided scientific advice to departmental staff and reviewed research reports and assessed their relevance to the department's responsibility. Many proposals were also submitted

directly to RMD during 1982/83 and were reviewed in the light of the division's objectives and program requirements.

During the year, the Research Management Division managed 57 contracts ranging from major inter-departmental and inter-disciplinary projects, such as the Cold Lake hydrology studies, to the organization of small internal workshops and the publication of monographs. Twenty-nine research projects were contracted to consulting companies, while another 21 contracts were provided to universities. The remaining contracts were with government agencies or were service contracts related to divisional operations. In addition, 14 research grants were awarded to Alberta universities and professional societies. A total of 27 reports on research projects were published by RMD during the year, and a number of articles related to RMD projects appeared in scientific journals. Additionally, researchers submitted interim or progress reports on long-term projects which remained unpublished. Staff members also published material through other agencies and in conference proceedings and journals.

As indicated by its budget allocation of $1 917 319.00 (Table 1), research in the oil sands regions of the province was given a high priority by the division. The office at Fort McMurray was used to support studies in the area. The investigation of environmental concerns arising from oil sands development and in situ recovery continued, with 39 research projects involving the oil sands area being activated. The base camp at Mildred Lake also served other government departments and agencies, and was made available on a cost- recovery basis to industry conducting environmental research.

A large portion of staff time was spent participating in the departmental, interdepartmental, and interagency committees which co-ordinate research programs. The division was represented on 47 committes, 12 being departmental committees, and the remainder interagency or interdepartmental committees such as the Reclamation Research Technical Advisory Committee (RRTAC), and the Federal/ Provincial Long-Range Transport of Atmospheric Pollutants (LRTAP) committees. Involvement in these committees has enhanced the

Table 1. Monies administered by the Research Management Division.

	1981/82	1982/83
Non-Oil Sands Research		
Administration	$ 456 634.00	$ 449 376.00
Projects (RMD funds)	$ 366 519.00	$ 487 743.00
Alberta Environmental Research Trust (direct)	$ 440 000.00	$ 440 000.00
Grants	$ 212 500.00	$ 212 500.00
Assets	$ 6 000.00	$ 50 000.00
TOTAL	$1 481 653.00	$1 639 619.00
Oil Sands Research		
Administration	$ 582 532.00	$ 397 745.00
Projects	$1 438 607.00	$1 483 574.00
Grants	$ 30 000.00	N/A
Assets	$ 41 000.00	$ 36 000.00
TOTAL	$2 092 139.00	$1 917 319.00

effectiveness of the division and its management capabilities, and has ensured that the professional staff have maintained an awareness of current environmental research activities in Alberta and elsewhere.

To further the division's expertise, RMD staff also attended and presented papers at scientific conferences and meetings in a variety of locations in Canada and the US. In addition, they sponsored workshops and seminars on various research topics.

Within the administrative arm of RMD, emphasis was placed on the streamlining of the division's administrative procedures with the aim to eventually implement a computerized management system.

Financial Data

As shown in Table 1, the total funds for RMD during the 1982/83 fiscal year were $3 556 938.00, with $1 639 619.00 being applied to non-oil sands research, and $1 917 319.00 to AOSERP. Although there was no increase in the budget over 1981/82, this year's reduction in administrative costs permitted the application of a greater portion of the budget to research.

The Research Management Division also endeavoured to increase the impact of its funds by augmenting them with funds from other sources. For instance, many of the division's projects involved external funding such as from the Heritage Trust Fund, or took the form of co-operative undertakings with private industry. As a result, RMD was able to purchase more environmental research with its dollars.

A Note as to the Organization of this Report

This report is based on the broad programs which are outlined in the introduction. Some specific references may be made either to location or to systems where appropriate. Projects which fall under AOSERP have been incorporated into the descriptions of the other programs.

ACID DEPOSITION PROGRAM

As in past years, research on acid forming emissions and their ecological effects was a major thrust in the division during 1982/83. The Acid Deposition Program was designed to plan and implement research specific to Alberta which deals with the environmental impacts and with the medium- to long-range transport of acid forming emissions (oxides of sulphur and nitrogen). In addition, the program will provide scientific information for reviewing and evaluating Alberta's air quality standards, and will assist in present and future planning of provincial industrial development. Finally, it will provide a good understanding of the potential for environmental acidification and will aid in sound, long-term environmental management.

The following specific program objectives were established:

1. to characterize sensitive environmental components and develop the methodologies to identify and/or predict environmental deterioration caused by acid forming emissions;
2. to determine the characteristics and quantities of local-source and long-range emissions, and to distinguish between their effects on the environment;
3. to review, co-ordinate, and implement a research program concerning acid forming emissions and their short- and long-term environmental effects; and
4. to develop a basis and an approach for preventive strategies and environmental protection.

One of the goals in designing the new Acid Deposition Program was to totally integrate all ongoing research studies. The following key steps were taken to achieve this goal:

1. Several of the existing research projects were re-directed to account for the episodic nature of acidic deposition and the consequent vegetation response. The components in the overall integration involved: continuous measurements of ambient air quality and its interface with vegetation responses at process, whole

plant, and population levels as well as the corresponding interface with soil nutrient and microbiological processes. These studies were amalgamated to emphasize the program dealing with the response of vegetation communities to aerial emissions which is being conducted in the AOSERP region.

2. A document was prepared to define the potential approaches required in interfacing air quality measurements to vegetation responses. This document was submitted to the Departmental Committee on Acid Deposition (DCAD).
3. A two-day workshop on "Ecological Monitoring Research" was organized at Red Deer, Alberta. The objectives of the workshop were to address industrial and governmental needs and concerns, and to develop plans for long-term research on the impacts of low level, chronic acidic deposition on forest ecosystems. A proceedings of the workshop was prepared and published by the Research Management Division to assist the planning of the new research program on acid deposition which is being sponsored by the Alberta Environment and industry.

The fiscal year saw the continuation of field sampling projects to analyse the chemical constituents of rain and snow in the Athabasca Oil Sands area. A satisfactory sulphur deposition model was developed to estimate deposition patterns around selected emissions sources. The creation of a methodology and the application of instrumentation technology for measuring the dry deposition of sulphur dioxide from sour gas plants achieved a high degree of success. These techniques will be used for measuring dry deposition of sulphur dioxide in the AOSERP area.

Two projects concerning the forecasts for sulphur and nitrogen oxides emissions for Alberta to the year 2000 were completed.

The division maintained, on behalf of the department, a high degree of involvement in various Acid Rain/Long Range Transport of Air Pollutants (LRTAP) committees. These committees were composed of representatives from federal and provincial governments and the private sector.

PROJECTS

Alberta Nitrogen Oxides Emissions Forecast 1980 to 2000

A forecast of nitrogen oxides emissions for Alberta was developed for the period 1980 to 2000. The forecast was based on two provincial growth profiles and the application of present, best practicable, and best available technology. Nitrogen oxides emission potentials were developed for each growth scenario and, through the application of current and developmental technologies, emission forecasts were developed for the natural gas, electric utility, oil sands, and other industries, as well as for the transportation and residential/commercial sectors.

Funding: $75 000.00

Alberta Sulphur Dioxide Emissions Forecast 1980 to 2000

This study developed a forecast of SO_2 emissions from Alberta's energy industries for the period from 1980 to 2000. The projected growth of the energy industry and new developments in SO_2 abatement technology were reviewed. The three forecast scenarios presented in the study were: (1) no changes in current control technology; (2) application of best practicable control technology; and (3) application of best available control technology.

Funding: $45 000.00

Ambient Air Quality: AOSERP Data

This project provided sound air quality monitoring data for use in determining the effects of aerial pollutant emissions on soil and vegetation processes. The monitoring site was approximately 20 km from the Syncrude and Suncor sites and was a focus for several related studies relevant to the permanent sample plot investigations.

Funding: $19 113.00

Aquatic Sensitivity Mapping

This project was designed to assess the sensitivity of Alberta lakes to acid precipitation. Phase I, initiated during 1982/83, involved identifying those lakes for which chemical composition data exist, and assessing, compiling, and tabulating this information. From these data, the existence of lake types or groups of lakes which may be sensitive to acid deposition will be ascertained. Future studies will involve the development of a methodology for quantifying the response of lakes to acidification. In addition, whole-lake sensitivity to acid deposition will be quantified and related to water chemistry selection, based on geographic and chemical criteria, of critical lakes as potential candidates for long-term monitoring.
Funding: $10 000.00

Atmosphere-Biosphere Interface: Numerical Model Generation

This study resulted in the development of numerical models to define such air quality predictors as frequency and intensity of pollutant episodes which best explain measured plant responses. Such models will be applied to analysis of the air quality impacts on vegetation in the AOSERP region.
Funding: $19 840.00

Chemistry of Summer Precipitation in the Oil Sands Area

Pollutants that are deposited by precipitation provide some indication of the amount and distribution of chemical elements and compounds that are present in the air. Sources of these chemical constituents can be either anthropogenic or be natural background.

To attempt an accurate determination of the chemical additives in rain, an ongoing sampling project was carried out to collect rainfall on an event basis in the AOSERP study area. The subsequent chemical analysis will be performed by the Alberta Environmental Centre (AEC) where the major anions and cations in the samples will be quantified.
Funding: $8 726.00

Chemistry of Winter Precipitation in the Oil Sands Area

As part of an ongoing project, the accumulated snowpack in the AOSERP area was extensively sampled and chemically analysed. The concentrations of the ionic and insoluble particulate constituents were determined. Deposition patterns and spatial variability of snowpack contaminant loadings were also studied to provide baseline data for future industrial development.

Funding: N/A (In House)

Determination of Dispersion, Pollutant Trajectories, Precipitation-Acidifying Processes, and Deposition Rates through Aircraft Measurements in the AOSERP Region

Through aircraft measurements, the pollutant dispersion coefficient, pollution trajectories, and precipitation-acidifying processes of sulphur dioxide emissions in the AOSERP area were determined. The project was initiated during the 1982/83 budget year, and will continue for three years.

Funding: $94 554.00 (Jointly funded by Research Management Division and Alberta Research Council)

The Effects of Nitrogen Oxides on Native Vegetation, Soils, and Water near a Compressor Installation

The sensitivity of select natural plant species to injury by low concentrations of nitrogen oxide and/or nitrogen dioxide stress was determined. Also examined were the effects of nitrogen oxides on the availability of certain plant nutrients in the soil. These studies will be integrated with the compressor station-ecosystem distribution inventory for Alberta, as well as information on known emissions of oxides of nitrogen.

Funding: $169 800.00 (Jointly funded by the Research Management Division and Standards and Approvals Division)

Impact of Air Pollutant Mixtures Characteristic of the Oil Sands Region on Forest Vegetation and Soils

This study investigated the effects on forest vegetation and soils of air pollutant mixtures characteristic of the oil sands region. The project was a joint research effort with the Canadian Forestry Service.

Funding: $43 585.00

Protection of the Biotic Environment

This study attempted to evaluate the relative effects of natural and anthropogenic (pollutants) factors on forest ecosystems. Morphologic and growth responses (past and present) in jack pine stands throughout the oil sands were studied to determine if pollution effects can be identified and quantified. The research was carried out under the auspices of an Alberta Oil Sands Technology and Research Authority Professorship.

Funding: $35 000.00 (Grant to University of Lethbridge Professorship)
$15 000.00 (Research contract)

The Response of Vegetation Communities to Aerial Emissions

This project determined structural dynamics in the boreal forest and compared any natural changes to those induced by aerial emissions. Results from this project will be used, in conjunction with findings from other studies, to develop sensitive and predictive indicators of aerial emissions (as an early warning). This will involve process-related phenomena and will establish the relationship between changes occurring in these processes, and the structure and function of the terrestrial ecosystem. This project has been integrated with other terrestrial studies.

Funding: $35 820.00

PUBLICATIONS

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RECLAMATION PROGRAM

Reclamation research by Alberta Environment was co-ordinated by the Reclamation Research Co-ordinating Committee, chaired by the senior manager of the Reclamation Program. In the province, such research concentrates on: determining methods of rebuilding productive soils (physically, chemically, and biologically); identifying changes in the quantity and quality of surface water and groundwater following disturbance and reclamation; developing native plant species for reclamation; controlling erosion; and improving materials-handling operations.

An RMD scientist continued essentially full-time managerial and administrative responsibilities for reclamation research in association with the interdepartmental Reclamation Research Technical Advisory Committee (RRTAC). In 1982, RRTAC committed approximately $1.5 million to a reclamation research program with sub-programs in the northeast oil sands region, in the coal-bearing region of the province's agricultural zone, and in the mountains and foothills.

A synthesis of reclamation information relevant to Alberta from over 1700 references in the international reclamation literature was undertaken. The final report, designed to provide direction for further research in the province, will be available in the summer of 1983. Approximately 870 references have been collected for inclusion in the second edition of the publication "Land Surface Reclamation: An International Bibliography."

An inventory of peat analyses methods from international research institutes has been compiled and synthesized. This inventory will be used by the International Peat Society to help develop standard international methodology.

The senior program manager has occupied the position of Vice-President of the Canadian Land Reclamation Association and is also editor of the quarterly Reclamation Newsletter.

Reports on reclamation projects are published through RRTAC rather than through RMD.

PROJECTS

NORTHEAST (OIL SANDS) REGION

Mycorrhizal Development on Severely Disturbed Soils

This study examined the potential of natural inoculum in stored peat and developed effective mycorrhizal associations for oil sands reclamation.

Two reports, presenting a synthesis of information collected from tests in large soil tanks at the University of Calgary, are expected to be published in 1983. Two additional reports will describe the nature and rate of microorganism establishment in mine spoils, and the influence of various reclamation treatments in creating a stable plant/soil system.

Funding: $116 700.00 (Funded by Land Conservation and Reclamation Council-Heritage Trust Savings Fund)

Oil Sands Soil Reclamation

A major literature review was undertaken to define the minimum physical, chemical, and biological properties of soil manufactured from tailings sand and locally-available materials which have the ability to support three vegetation types. These include vegetated tailings-pond dyke slopes, and mixed wood spruce/aspen forests and jack pine forests on mined areas. The final report will be published in 1983, and will identify gaps in knowledge and provide recommendations for further research provided.

Funding: None in 1982/83

Oil Sands Tailings Soil Reconstruction

Arising from the previous study, a joint government/industry reclamation project was initiated to identify methods of reconstructing soils from tailings sand, peat, and clayey materials which will support a self-maintaining woody shrub and tree cover. A flat tailings sand

experimental site was constructed on the Syncrude Canada Ltd. lease and research will begin in 1983/84.
Funding: None in 1982/83

PLAINS REGION

Assessment of Reclamation Potential and Hydrologic Impacts of Large-Scale Surface Mining of Coal in Plains Areas in Alberta

The objective of this project was to develop a predictive framework for projecting both the success of reclamation and the long-term impact of mining on water resources. Differences in physical and chemical properties of the pre-mining soils, overburden, and subsurface water were used as keys to gauge post-mining conditions. The predictive framework is to be based on an understanding of the processes acting within the landscape so that, in the future, mine sites that are not totally analogous to those that have been studied can also be evaluated.

The project involved an holistic approach to reclamation through the integration of studies on geology, hydrogeology, and soils, not only in a proposed mining area, but also in the adjoining unmined areas. This approach permits the assessment of impacts and long-term performance in both areas.

Several final reports will be available in 1983.
Funding: $1 091 747.00 (Land Conservation and Reclamation Council-Heritage Trust Savings Fund)

Native Plant Material for Site Development

This project was designed to identify native forb species suitable for reclamation of reservoirs in southern Alberta. Species were first tested to determine optimum methods for propagation, and were then grown in greenhouses. Field trials were used to assess planting success.

A final report providing information on plant form, phenology, habitat distribution, propagation, reclamation suitability, and references will be available by summer 1983.

Funding: $44 000.00 (Jointly funded by Research Management Division and Planning Division)

Soil Reconstruction Project/Battle River

This study was designed to determine the types and amounts of materials needed to amend sodic mine spoils. The ability to restore and maintain agricultural productivity will be a measure of the success of the various amendments.

Funding: $144 000.00 (Jointly funded by Land Conservation and Reclamation Council-Heritage Trust Savings Fund; Alberta Power; Luscar Ltd.; and Manalta Coal Ltd.)

Soil Reconstruction Project/Highvale

A project similar to that noted above was initiated at the Highvale mine site. While the purpose of the research was similar, some changes in experimental design were made to account for the different soils, agricultural practices, and end land uses in the area.

Funding: $32 777.00 (Jointly funded by Land Conservation and Reclamation Council-Heritage Trust Savings Fund and Transalta Utilities)

MOUNTAINS AND FOOTHILLS REGION

Feasibility of Genetic Improvement of Native Alberta Grasses

This project attempted, through mass selection, to develop improved lines of native Alberta grasses for reclamation, erosion control, and wildlife range improvement in alpine and subalpine areas of Alberta. Four test sites were established in 1981 to provide the data required for licence application; three species of Agropyron are being

tested against commercial varieties. Licencing may be possible as early as 1985. Selection of several high-elevation species is continuing.
Funding: $101 528.00 (Funded by Land Conservation and Reclamation Council-Heritage Trust Savings Fund and Parks Canada)

GENERAL

International Inventory of Fertility Analysis for Peat Soils

Peat fertility is a poorly understood subject that has received minimal investigation in North America. Under the auspices of the International Peat Society, an RMD scientist is compiling an international inventory of peat analyses methods used by research institutes where more relevant research has been carried out. The inventory will be used to help develop standard international methodology for peat analysis.
Funding: $8 000.00

Reclamation Research Review

International reclamation literature is being collected by RMD staff and compiled in a bibliography. A computer program has been developed to allow users to search the bibliography. The data base is kept on a SPIRES file at the University of Alberta. An additional 870 references were added to the computer data base in 1982/83.

Divisional staff are preparing a synthesis of literature referenced in the bibliography. This report, to be published in the summer of 1983, will provide direction for further research in the province.
Funding: $11 000.00 (Funded by the Land Conservation and Reclamation Council-Heritage Trust Savings Fund)

ENVIRONMENTAL CONTAMINANTS PROGRAM

The Environmental Contaminants Program was initiated during 1982/83 to integrate ongoing research efforts with departmental activities and to develop a long-term research strategy in the area of environmental contaminants.

The program objectives include:

1. the development of a mechanism for identifying and assigning research priorities to contaminants of concern to Alberta; and
2. the development of a mechanism whereby information relative to the fate and effects of contaminants can be accumulated in order to direct mitigative action.

During the reporting period, a series of draft program documents were produced describing the basic program concepts and preliminary research priorities, and outlining a tentative research strategy. These documents were circulated to the operational divisions of Alberta Environment and to the Alberta Environmental Centre for comment.

Ongoing research assigned to this program included the second year of a project which identified the chemical components of the products of in situ oil sands combustion processes and determined associated environmental hazards. Also incorporated into the program was the second and final year of a project designed to develop a model to improve the prediction of phosphorus content in Alberta lakes. A student thesis to produce an improved methodology for calculating nutrient budgets for shallow productive lakes in Alberta was associated with this project.

A major international workshop, the Ninth Annual Aquatic Toxicity Workshop, was organized and funded under the Environmental Contaminants Program in 1982. This workshop was a joint venture between Alberta Environment, the Alberta Environmental Centre, the University of Alberta (Department of Zoology), the University of Calgary (Kananaskis Centre for Environmental Research), the Alberta Oil Sands Technology and Research Authority (AOSTRA), and Syncrude Canada Ltd.

PROJECTS

Improving the Estimate of Phosphorus in Local Lakes

The objectives of this project were to develop a model to predict the portion of the phosphorus pool tied up in the larger plankton of local Alberta lakes, and to improve the models for predicting lake water phosphorus.

Funding: $39 628.76

Ninth Annual Aquatic Toxicity Workshop

The purpose of this annual workshop, held on 1982 November 1 to 5, is to provide a forum for discussion and information transfer in the field of aquatic toxicology. Participants are from government agencies, industry, consultanting companies, and universities. The Edmonton workshop was co-sponsored by provincial and federal government agencies, universities, and industry.

Funding: $10 000.00 (Grant)

Oil Sands In Situ Combustion Products

This project was undertaken to chemically identify contaminants in the fluids and gases generated by in situ fire-flood produced bitumen, and to identify the possible environmental hazards and human health risks arising from these toxic and carcinogenic materials.

Funding: $100 000.00 (Jointly funded by Research Management Division and Alberta Oil Sands Technology and Research Authority)

Prediction of Productivity and the Behaviour of Phosphorus in Shallow Non-Stratified Lakes

The purpose of this project was to collect data for the calculation of a nutrient budget for three shallow productive lakes in the Edmonton area and to estimate the phosphorus return from the sediments by examining the difference between input and output. The data will be used, along with literature examples, to develop general

models for these unusual lakes, focusing both on quantity and rate of nutrient return from the sediments.

Funding: $10 000.00 (Grant)

A Study of the Effects of Low Levels of Ethylene Gas on the Growth of Crop Plants

This study was designed to determine the effects on typical Alberta crops of both long-term, low-level exposure to ethylene and pulses of more concentrated ethylene, especially at sensitive periods of plant growth.

Funding: $39 397.00 (Jointly funded by Alberta Gas Ethylene and Dow Chemical Company of Canada Ltd. and the Research Management Division)

WASTE MANAGEMENT PROGRAM

The development of the Waste Management Program during the fiscal year was structured along two principal research areas reflecting Alberta Environment's mandate in the field of managing wastes. These two research areas or sub-programs are: social policy research and technology research.

Social policy research addresses issues relevant to executive decision making. Specific lines of enquiry are legislative and institutional research, facilities demand forecasting, public perceptions and attitudes, economics of waste management, and public participation and education.

Technology research involves problems in engineering design and facilities operations. The proposed lines of enquiry under this sub-program are: assessment of existing technology; development of new technology; environmental assessment; and identification of specific environmental contaminants. Research in this area will involve waste processing systems, waste disposal systems, recycling technology, materials handling technology, and site evaluation hardware.

The Waste Management Program also incorporated appropriate divisions of Alberta Environment and the Alberta Environmental Centre, Vegreville. Research assigned to this program included a study of possible health problems resulting from land disposal of treated sewage.

PROJECTS

Potential Health Problems Caused by the Disposal of Treated Sewage Products Containing Parasites

The third, and final, year of this project involved: the completion of work detailing the survival of worm pathogens from sludge in soil; the detection, identification, and survival of primary and secondary pathogenic bacteria on soil; and the continuation of work on viral detection. Comparisons between sludged fields, unsludged fields, and farm pastures were made to estimate health risk.

The results from this three-year research project were presented at a conference in November 1982. A book, entitled "Biological Hazards Associated with the Terrestrial Disposal of Sewage Sludge in Cold Climates," was based on the conference, and is in the process of being published by the University of Calgary Press.

Funding: $95 000.00 (Jointly funded by Research Management Division and Standards and Approvals Division)

SOCIO-ECONOMIC ANALYSIS PROGRAM

Definition of the Socio-Economic Analysis Program was completed during the year and included a five-year research needs projection. The program researches human-biophysical environmental relationships and environmental studies, with its primary concern being social impact assessment and public participation.

With the completion of the 1982 Edmonton area study by the Population Research Laboratory of the University of Alberta, the results of three years of public opinions on environmental issues were analysed and published.

The "Population Turnover in Fort McMurray: Phase 1" study was completed. The majority of persons who participated in the 1979 study of "Family Adjustment in Fort McMurray" were located and a comprehensive questionnaire was designed and pre-tested.

Partial funding was provided in support of the Four Nations Conference (Scotland, Norway, USA, and Canada) on "Community Impacts and Development Issues in Energy Resource Communities" at the Universities of Alberta and Calgary.

Preliminary research was begun on the effects of plant closures on resource communities. In order to select a location which would provide optimum data, demographic and economic parameters were evaluated. The project will assess the socio-economic impacts of plant closures on the quality of life of individuals and families within an as yet undetermined community in Alberta. The appropriate social and economic issues will be decided upon by a thorough review of secondary data sources and through interviews with community leaders.

Background documentation and initial project rationales were developed for research into the cumulative impacts of multi-energy developments. This is an exploratory study designed to identify the effects of several types of energy-related developments taking place at one time in a particular community.

PROJECTS

Edmonton Environmental Survey

The Population Research Laboratory, University of Alberta, conducts a yearly survey, covering many subject areas, of a large sample population in Edmonton. For three consecutive years, the Human System has funded the Population Research Laboratory for the inclusion of questions about the environment in order to gauge points of view on that subject. The first report analysing three years of data was published in 1982.

Funding: $4 000.00

Four Nations Conference on "Community Impacts and Development Issues in Energy Resource Communities"

This conference was sponsored by the University of Alberta and the University of Calgary. The conference brought together individuals from several different countries to provide perspectives on the issue of socio-economic analysis. The conference was organized to: (1) review empirical studies relevant to each area; (2) assess specific issues experienced in regions undergoing rapid growth due to resource development; and (3) determine how problems are dealt with and by what agencies.

Funding: $5 000.00

An Integration and Synthesis of AOSERP Human System Research Results

Since 1975, data have been collected under the auspices of AOSERP to determine the changes that have taken place in the oil sands area due to the development of the area's resources. This project will provide a synthesis of the data collected to date.

Funding: None in 1982/83.

Policy Analysis of Fort McMurray Data

Data collected in a 1979 field study of family adjustment in Fort McMurray were re-analysed and re-interpreted in the light of

planning and policy options for the proposed new town in northeastern Alberta. Policy options data were provided by the New Town Planning Board. The re-interpreted information is intended to be used for future planning.

Funding: None in 1982/83

Population Turnover in Fort McMurray: Phase I

People who participated in the 1979 study, "Family Adjustment in Fort McMurray" and who had since moved away were located. A substantial questionnaire which would identify reasons why people moved from resource towns was designed and pre-tested.

Funding: $32 225.00

PUBLICATIONS

Edwards, F.E. 1983. South Saskatchewan River basin planning project: documentation of public participation component. Prep. for Alberta Environment, Planning Division by Research Management Division. Edmonton, Alberta. 15 pp.

Edwards, F.E., H. Krahn, J. Sklofsky, and D.W. Stokes. In prep. Project summary: policy translation, New Resource Towns Planning concerns. Prep. for Alberta Environment, Research Management Division. RMD Project 81-27.

Krahn, H. 1982. Attitudes toward the environment: Edmonton, 1980 to 1982; Winnipeg, 1981. Prep. for Alberta Environment, Research Management Division by Thames Group Research. Edmonton, Alberta. Report OF-45. 82 pp.

Krahn, H. 1983. Environmental issues in Alberta: The opinions of Edmonton residents. Prep. for Alberta Environment, Research Management Division by Thames Group Research. Edmonton, Alberta. RMD Report 82/17. 25 pp.

ENVIRONMENTAL ASSESSMENT PROGRAM

Definition of the Environmental Assessment Program was not fully achieved during the fiscal year, and further examination of the scope and intent of the program will continue. Preliminary discussions defined this area of research as a program for data collection and interpretation in order to describe and evaluate environmental trends and conditions. A number of projects relating to the Cold Lake area and to Turtle Mountain in the Crowsnest Pass were conducted under this program.

PROJECTS

COLD LAKE AREA

Cold Lake Seismic Array

This ongoing project provides baseline seismicity information in the Cold Lake Oil Sands area. Further objectives are: to identify the source locations of the observed events and to identify or suggest their causes; to describe the environmental significance of observed seismic events and their relationship to current activities; to make recommendations concerning ongoing monitoring after the basic study is completed; and to design mitigative engineering features. Operation of the array and the dissemination of data has been transferred to Earth Sciences Division.

Funding: None in 1982/83

Processing and Analysis of Cold Lake Seismicity Data

This project was initiated to obtain data reduction and analysis services for digital seismic data from the Cold Lake Digital seismic array. A further objective was to initiate research into induced phenomena associated with in situ extraction of bitumen from the Alberta Oil Sands.

Funding: $25 000.00 (Funded by a grant from Esso Resources Ltd. to the University of Alberta)

A Regional Assessment of Hydrogeological and Hydrochemical Conditions in the Cold Lake Oil Sands Deposit

This project was integral to the department's effort to assess the extent and quality of groundwater resources in the Cold Lake region and to protect the resources from contamination by industrial activity. At present, no technology exists for a quantitative prediction of the potential regional effects of lost process- or wastewaters on a pre-existing groundwater regime (in three dimensions and in the presence of high pressure, high temperature steam injected in a widely

distributed pattern of boreholes). This project sought to establish such a technology through the development of a three-dimensional framework of the hydrostatigraphy, hydrodynamics, and hydrochemistry of the Cold Lake Oil Sands area. It will also identify the processes inherent to both in situ recovery and deep waste disposal methods, and evaluate their possible effects on local and regional groundwater regimes. Recommendations will be made for further study aimed at the quantification of these potential impacts for both local and regional scales.

Funding: $554 000.00 (Jointly funded by Research Management Division and Alberta Research Council)

TURTLE MOUNTAIN

Deformation Monitoring of Turtle Mountain by High Precision Analytical Photogrammetry

The purpose of this project was to develop, test, and implement a photogrammetric monitoring system for the south peak of Turtle Mountain. This system must be capable of detecting multi-point movements to an accuracy level of 10 mm.

This project was integrated with "Monitoring the South Peak of Turtle Mountain: Phase III."

Funding: $15 000.00

Investigation of Seismic Activity in the Turtle Mountain Potential Slide Area

A length of the Turtle Mountain coal seam, mined after the 1903 rock slide which partially destroyed the town of Frank, has been identified as a possible site for the occurrence of stress relief which might lead to a second great slide. By placing seismic recording instruments in the immediate vicinity of this unstable area, the goal of the proposed study was to identify and locate any seismic events occurring in this area and to determine their usefulness as warnings of

a future slide. Depending on the results of the first phase of study, a permanent seismic monitoring system may be established.

Operation of the monitoring system was the responsibility of the Earth Sciences Division.

Funding: $25 000.00

Monitoring the South Peak of Turtle Mountain: Phase III

This study was undertaken to determine whether a mass of rock outlined on Turtle Mountain by Allan (1933) is in motion and is, therefore, likely to slide into the Crowsnest Valley in the future. A further objective was to develop techniques for monitoring the stability of large rock masses. A design memorandum recommending standard monitoring techniques with the ultimate objective to ensure public safety will be produced at the conclusion of the study.

Phase I of this project, carried out in 1980, involved the continued monitoring of the crude network established by Allan in 1933 and the installation of an improved monitoring network. In 1981 (Phase II), monitoring of this network detected some significant movements. Continued monitoring in 1982 was supplemented by geotechnical mapping of the displaced mass of rock.

Funding: $15 501.50

Remote Electro-Optical Distance Metre Monitoring of Fractures on Turtle Mountain

The purpose of this project was to design an electro-optical distance metre (EDM) survey and develop a measuring and analysis procedure for remote monitoring of movements of the fractured rock masses on Turtle Mountain. Subsequent research will field test the procedure and consider its potential for more general applications, including dam monitoring.

This project was integrated with "Monitoring the South Peak of Turtle Mountain: Phase III."

Funding: $10 000.00

Turtle Mountain Study: Aerial Photography

Low-level aerial photography was conducted for use in the project on "Deformation Monitoring of Turtle Mountain by High Precision Analytical Photogrammetry."

Funding: $2 100.00

OTHER

Co-operative Program in Surface Water Engineering

This program is a continuation of joint research projects in fluvial mechanics and river engineering, surface water hydrology, sediment yield studies, and ice formation and breakup in streams.

Projects within the program were sited throughout Alberta and were designed to investigate long-term, slowly changing, or randomly occurring hydrologic phenomena. Most of the processes must be observed continuously over several decades.

Individual studies were identified by line agencies within Alberta Environment and Alberta Transportation on the basis of their impact on public safety or on protection of property, or to fulfill a defined need for information to be used in the design of hydraulic structures. Information derived from the program was also used for enforcement of the Water Resources Act and Regulations.

Funding: $537 800.00 (Jointly funded by Research Management Division, Alberta Research Council, and Alberta Transportation)

Development of a Model to Predict Winter Oxygen Deficits in Local Lakes of Central Alberta

This project was designed to measure winter oxygen depletion in several local lakes of central Alberta with a goal to develop a model to predict the process of such depletion.

Funding: $10 000.00 (Grant)

Doppler Sounder Measurements of Calgary Wind Climatology

Acoustic sounders appear to offer a practical and relatively inexpensive method of obtaining wind profiles from the ground surface up to several hundred metres. A sounder was installed at Springbank Airport, near Calgary, to measure windspeed and direction at altitudes between 75 and 500 m. These data have been examined to determine their statistical properties and have been compared with winds measured near ground level at four sites in the Calgary area. Results indicate that there are stronger topographic influences on the ground level winds as compared to the upper winds.

Funding: $39 221.23

Further Work on Denil Fishways

The validity of model-prototype relationships was investigated for the Denil 2 fishway for one model with a scale of about one-third. Upon model verification, some flow measurements for higher d/b values were made and flow conditions at the inlet and outlet were examined. This project laid the groundwork for more detailed studies on: (1) the effects of large d/b values; and (2) inlet and outlet flow conditions.

Funding: $30 810.00 (Funded by Design and Construction Division)

Nitric Acid, Peroxyacetyl Nitrate, and Particulate Nitrate in the Calgary and Edmonton Atmospheres

This work is a continuation and expansion of research into the occurrence and behaviour of pollutants in the urban atmosphere of Calgary. Earlier investigations of peroxyacetyl nitrate (PAN) were continued with an additional research thrust toward the occurrence and chemistry of nitric acid.

Nitric acid is now believed to be the major secondary pollutant formed by the oxidation of anthropogenic emissions of nitrogen oxides in the urban atmosphere. It is a strong acid and one of the major causes of acid rain, contributing up to 50% of the acidity in heavily urbanized areas of the United States. Calgary and Edmonton, because of their unique geographical settings and meteorological conditions, are subject to high concentrations of nitrogen oxides and to

rapid changes in concentration. The objective of this study was to measure the nitric acid content of the Calgary and Edmonton atmospheres, and to determine diurnal and seasonal variations. A second objective is to determine the mechanisms of nitric acid formation and the relationship between nitric and nitrogen oxides, peroxyacetyl nitrate, particulate matter, and ozone.

Funding: $70 000.00 (Grant)

Systems Analysis of Irrigation Water Conveyance Systems

This project evaluated the feasibility of developing a physically-based computer simulation model. The model will permit an evaluation of the factors that influence the overall conveyance efficiency of a typical irrigation district distribution system in Alberta.

Funding: $13 000.00 (Grant from RMD)
$26 000.00 (Planning Division)

Update of the Physical Climatology of the Athabasca Oil Sands Region

Since 1976, the Research Management Division has been involved in the collection of meteorological data from nine stations in the Modular Acquisition Processing System (MAPS) network in the Athabasca Oil Sands region of northeastern Alberta. A previous study (Longley and Janz), which synthesized available long-term climate records, presented a descriptive overview of the area's climate. With the automated MAPS network coming on stream in late 1976, a more comprehensive data base became available. The objective of the present study was to update and synthesize the long-term climate data for the region, incorporating the short-term data records from the MAPS network.

Funding: $36 700.00

PUBLICATIONS

Baker, B.L., T.I. Ladd, S.A. Telang, J.W. Costerton, and G.W. Hodgson. 1982. The biogeochemistry of streams: the Red Deer River. Prep. for Alberta Environment, Research Management Division by the Kananaskis Centre for Environmental Research and the Department of Biology, University of Calgary. Edmonton, Alberta. RMD Report 82/15. 202 pp.

Chorley, D.W., F.W. Schwartz, and A.S. Crowe. 1982. Inventory and potential applications of groundwater flow and chemistry models. Prep. for Alberta Environment, Research Management Division by Department of Geology, University of Alberta. Edmonton, Alberta. RMD Report 82/7. 73 pp.

Cruden, D.M. 1983. Monitoring the south peak of Turtle Mountain: Phase II. Prep. for Alberta Environment, Research Management Division by the Department of Civil Engineering, University of Alberta. Edmonton, Alberta. Report OF-46. 43 pp.

Danard, M. and M. Gray. 1982. Modelling the topographic effects on winds in the Alberta oil sands area. Prep. for Alberta Environment, Research Management Division by Atmospheric Dynamics Service. Edmonton, Alberta. AOSERP Report 126. 89 pp.

Davison, D.S., M.J.E. Davis, R.D. Rudolph, and M.C. Hansen. 1982. Airshed management system for the Alberta oil sands. Volume III: meteorological data. Prep. for Alberta Environment, Research Management Division by Intera Environmental Consultants Ltd. and Western Research and Development. Edmonton, Alberta. AOSERP Report 124. 129 pp.

Gray, J.M.L. and G.G. Goyer. 1983. Injection of silver iodide from cloud seeding into the atmosphere of central Alberta. Prep. for Alberta Environment, Research Management Division by the Alberta Research Council. Edmonton, Alberta. RMD Report 83/20. 34 pp.

Hage, K.D. and P. Hopps. 1982. A new air pollution model for Edmonton: Part I. Prep. for Alberta Environment, Research Management Division by Department of Geography, Meteorology Division, University of Alberta. Edmonton, Alberta. RMD Report 82/14. 37 pp.

Hage, K.D. and P. Hopps. 1982. A new air pollution model for Edmonton: Part II. Additional carbon monoxide measurements in the North Saskatchewan River Valley in Edmonton. Prep. for Alberta Environment, Research Management Division by Department of

Geography, Meteorology Division, University of Alberta. Edmonton, Alberta. RMD Report 82/10. 26 pp.

Hansen, M.C. and M.D. Jones. 1982. An assessment of collection and handling of climate data by Alberta Government agencies. Prep. for Alberta Environment, Research Management Division by Western Research, Division of Bow Valley Resource Services Ltd. Edmonton, Alberta. RMD Report 82/12. 45 pp.

Hickman, M., S.E.D. Charlton, and C.G. Jenkerson. 1983. A comparative study of benthic algal primary productivity in the AOSERP study area. Prep. for Alberta Environment, Research Management Division by the Department of Botany, University of Alberta and Department of Plant Sciences, University of Western Ontario. Edmonton, Alberta. AOSERP Report 128. 154 pp.

Kanasewich, E.R., C. Gold, D.T. Sneddon, M. Burke, and D. Kenway. 1983. The Cold Lake digital seismic monitoring array. Prep. for Alberta Environment, Research Management Division by Department of Physics, University of Alberta, Alberta Environment, and Druid Electronics Ltd. Edmonton, Alberta. RMD Report OF-49.

Klemm, R.F. and J.M.L Gray. 1982. A study of the chemical composition of particulate matter and aerosols over Edmonton. Prep. for Alberta Environment, Research Management Division by Alberta Research Council. Edmonton, Alberta. RMD Report 82/9. 125 pp.

Parker, G. 1982. Scour and transport of coarse river bed material. Prep. for Alberta Environment, Research Management Division by the University of Calgary. Edmonton, Alberta. RMD Report OF-47. 91 pp.

Peake, E. In prep. Peroxyacetyl nitrate in the Calgary atmosphere. Prep. for Alberta Environment, Research Management Division by the Kananaskis Centre for Environment Research, University of Calgary. RMD Project 80-29.

Rudolph, R.C., M.M. Oleskiw, and R.A. Stuart. In prep. Update of the physical climatology of the Athabasca oil sands area. Prep. for Alberta Environment, Research Management Division by Intera Environmental Consultants Ltd. RMD Project 82-5.

Sneddon, D.T. 1983. Hydrotechnical research in the Alberta Oil Sands. Prep. by Alberta Environment, Research Management Division. Edmonton, Alberta. RMD Report OF-50. 34 pp.

Sneddon, D.T. 1983. The effects of seismic blasting on water wells. Prep. by Alberta Environment, Research Management Division. Edmonton, Alberta. RMD Report OF-51. 247 pp.

Turchenek, L.W. and J.D. Lindsay. 1982. Soils inventory of the Alberta Oil Sands Environmental Research Program study area. Prep. for Alberta Environment, Research Management Division by Alberta Research Council. Edmonton, Alberta. AOSERP Report 122. 240 pp.

Turchenek, L.W. and J.D. Lindsay. 1983. Soils inventory of the Alberta Oil Sands Environmental Research Program study area: Appendix 9.4 to AOSERP Report 122. Prep. for Alberta Environment, Research Management Division by Alberta Research Council. AOSERP Report L-80. 272 pp.

Wallis, P.M., M.E. Van Zinderen Bakker, and J.M. Buchanan. 1983. Microbiological and organic geochemical studies in reclaimed coal mine backfill at a mountain and a prairie minesite in Alberta. Prep. for Alberta Environment, Research Management Division by the Kananaskis Centre for Environmental Research, University of Calgary. Edmonton, Alberta. RMD Report L-81. 206 pp.

TECHNOLOGICAL ASSESSMENT PROGRAM

After reviewing the background literature, the Technological Assessment Program was preliminarily defined as "a systematically and generally orientated assessment of the environmental consequences of using a definite existing or foreseen technology." A project was under way at year's end to determine the scope of the program and identify research priorities relevant to Alberta.

Review and assessment by the department of the latest available environmental technologies is an ongoing process. During the year, a research project on the review of the technology available for the control of atmospheric emissions from oil sands plants was completed by the division.

PROJECTS

Identification of Research Requirements for Technological Assessment

Through the review of the recommendations of various published reports dealing with technology and through personal interviews with appropriate individuals in government and industry, this study will identify and assign priorities to environmental research areas of importance to Alberta. A framework for a technological assessment program for the next five years will be developed.
Funding: $15 000.00

A Review of the Technology Available for the Control of Atmospheric Emissions from Oil Sands Plants

This project provided an overview of the technology available for the control of atmospheric emissions of sulphur dioxide and nitrogen oxides from oil sands plants. A review of established technology for the extraction and upgrading of oil sands bitumen and the potential application of these processes to an oil sands plant was provided. Consideration was given to the capacities of individual processes. In addition, the development that is required in a typical oil sands context and to fix the basis of the process economics was extrapolated.
Funding: $76 058.83

PUBLICATIONS

Hart, A.G., R.G. Humphreys, A.L. McMullen, and B.U. Patel. 1983. A review of the technology available for the control of emissions from oil sands plants. Prep. for Alberta Environment, Research Management Division by Dynawest Projects Ltd. Edmonton, Alberta. RMD Report 83/19. 293 pp.

RISK ANALYSIS PROGRAM

This program was initiated by the division in September of 1982 and has yet to be fully defined or implemented. Work in this area has consisted of computer data base literature searches, divisional program development, and initiation of a project to define and develop a research plan for the program.

PROJECTS

Risk Analysis Program Development

The purpose of this project was to outline a five-year risk analysis research program for Alberta Environment. The final report will include: a definition of risk; the determination of the scope of the program; an inventory of processes and systems in Alberta which may require study; a description of current risk analysis methodology; and a detailed five-year research program outline.

Funding: $15 000.00

ENVIRONMENTAL EMERGENCIES

Details of environmental emergency procedures established by several different agencies were documented to ascertain which areas require research. A provisional program package is now in the process of being evaluated as to its relation to departmental needs.

LIBRARY

The Library Services Branch is responsible for collecting, housing, and disseminating resources vital to the information needs of Alberta Environment staff. Private industry, members of the public, and the university community also make use of its resources. Services provided include the ordering of all books, documents, and periodicals for the department; the organization of these materials for maximum retrieval of information; answering of reference queries; handling of interlibrary loans; and the enhancement and supervision of regional office library services.

During the fiscal year, over 2500 items were added to the library's catalogued collection. Utilization of the collection continued to be high as indicated by the circulation of over 14 000 items. The library makes its collection available to other government departments, as well as to public, university, and private libraries by means of the interlibrary loan system. In 1982/83, it was a net lender. More than 1500 items were borrowed from the library, while only 1300 items were required to supplement our information resources in order to meet staff needs.

Reference is a major service provided by the library, and this year staff answered more than 3900 questions, including 117 computerized literature searches. Three bibliographies on three Alberta river basins were also compiled in response to staff needs for information on these topics.

Automation is playing a major role in helping the library to makes its resources more accessible to users. Computerized information retrieval services have been available for some years, and cataloguing records are now being converted from card format to machine-readable form. In co-operation with the Alberta Agriculture and Alberta Research Council libraries, the Environment Library has developed the Sci/Tech data base, and is sharing its records for cataloguing and interlibrary loan purposes. More than 7000 records have been entered into the data bank in this fiscal year, and it is hoped that the conversion of existing records will be completed by March 1984.

In February, the responsibility for the library was transferred to Finance and Administration Services.

PROJECTS

Sci/Tech Data Bank

This was co-operative project undertaken to automate the cataloguing records of the library. Included in this project were costs for development and refinement of the data bases and conversion of existing records to machine-readable form.

Funding: $100 000.00 (Jointly funded by Alberta Environment, Alberta Agriculture, and Alberta Research Council)

PUBLICATIONS

Bramm, S. 1983. A bibliography of the Athabasca river basin, Alberta. Prep. by Alberta Environment Library. Edmonton, Alberta. 125 pp.

Bramm, S. 1983. A bibliography of the Peace/Athabasca delta. Prep. by Alberta Environment Library. Edmonton, Alberta. 41 pp.

Bramm, S. 1983. A bibliography of the Peace and Slave river basins, Alberta. Prep. by Alberta Environment Library. Edmonton, Alberta. 66 pp.

COMMITTEES

Committees which will have Research Management Division representation are listed below.

DEPARTMENTAL

Advisory Committee for the Research Study "Determination of the Source of Sulphate in Groundwater in the Lakeside Feedlot Area near Brooks, Alberta"

Air System Research Committee

Analytical Services for the Pollution Control Division at the Alberta Environmental Centre, Aquatic Working Group

Analytical Services for the Pollution Control Division at the Alberta Environmental Centre, Air Working Group

Departmental Committee on Acid Deposition

Departmental Committee on Sour Gas

Directors/Assistant Deputy Minister Environmental Protection Services Committee

Environmental Contaminants, Ad Hoc Committee, Alberta Environmental Centre

Library Committee

Pulp and Paper Mill Effluents Committee

Reclamation Research Co-ordinating Committee (RRCC)

Waste Management Research Committee

INTERAGENCY

Associate Committee on Scientific Criteria for Environmental Quality National Research Council (Environmental Secretariat)

Associate Committee on Scientific Criteria for Environmental Quality Subcommittee on Air; National Research Council (Environmental Secretariat)

Alberta Climate Advisory Committee

Alberta Environmental Research Trust Grants Advisory Committee (AERT/GAC) (Alberta Environment, Alberta Chamber of Resources, University of Calgary)

Alberta Environmental Centre Technical Advisory Committee (AEC/TAC)

Alberta Fishways (Alberta Environment, Alberta Energy and Natural Resources, Environment Canada)

Alberta Government Libraries Council

Alberta Petroleum Industry/Government Environmental Committee (APIGEC): Steering Committee on Acid Gases in the Environment (SCAGE)

Atmospheric Sciences Program Subcommittee (Alberta Research Council)

Canadian Climate Planning Board (Environment Canada)

Canadian Petroleum Association/Environmental Research Advisory Committee (CPA/ERAC)

Cumulative Impact Group

Dickson Dam Monitoring Committee

Energy Research Program Technical Advisory Committee

Federal/Provincial LRTAP/Acid Rain Research and Monitoring Co-ordinating Committee (RMCC); Atmospheric Sciences Group (Environment Canada)

Federal/Provincial Long Range Transport of Atmospheric Pollutants Research and Monitoring Co-ordinating Committee (RMCC)

Kananaskis Policy Advisory Committee (KPAC)

Lake Wabamun Scientific Advisory Committee

Lake Wabamun Watershed Advisory Committee (LWWAC)

Long Range Transport of Atmospheric Pollutants in Western Canada (LRTAP) Technical Committee (British Columbia, Alberta, Saskatchewan, Manitoba, Northwest Territories, and Canada)

Ninth Annual Aquatic Toxicology Workshop Organizing Committee (Alberta Environment, Alberta Environmental Centre, University of Calgary, Syncrude Canada Ltd., Environment Canada)

Oil Sands Soil Reconstruction Project Technical Committee (Alberta Environment, Alberta Forest Service Industry)

Peace-Athabasca Delta Monitoring Committee (Department of the Environment, Department of Energy and Natural Resources, Environment Canada)

Plains Aquatic Research Group (Alberta Environment, Environment Canada, Fisheries and Oceans Canada, Saskatchewan Environment, University of Calgary, Montana State University)

Plains Coal Reclamation Research Program Steering Committee (PCRRP)

Reclamation Research Technical Advisory Committee (RRTAC)

Scientific Advisory Committee to the CPA/ERAC Study "Land Disposal of Oily Wastes"

Scientific Committee; Canadian Meteorological and Oceanographic Society (CMOS)

Second International Forum on the Human Side of Energy Steering Committee

South Saskatchewan River Basin Planning Project, Planning Committee

Statistical Co-ordinating Committee

Surface Water Research Advisory Committee (Alberta Research Council and Department of Environment)

Third International Symposium on Regulated Streams Organizing Committee (Alberta Environment, Syncrude Canada Ltd., University of Calgary, University of Alberta)

United States-Canada Transboundary Air Pollution Impact Assessment Work Group (Environment Canada)

Water Subprogram Committee, Alberta Research Council (Alberta Environment, Alberta Agriculture, Alberta Transportation, Alberta Research Council, University of Alberta, Canada West Foundation, Irrigation Secretariat)